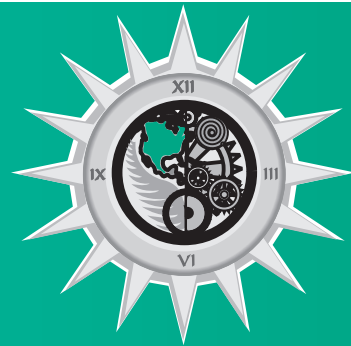


ESAVE

Environmental Stewardship &
Value Engineering

Quarterly Newsletter for the Nuclear Weapons Complex



'Hybrid' lighting could boost solar power indoors

With a novel application of solar energy, a research team at the U.S. Department of Energy's (DOE) Oak Ridge National Laboratory (ORNL) seeks to rectify the amount of energy required to light building interiors.



Michael Cates, left, and Jeff Muhs of Oak Ridge National Laboratory play with fiber optic equipment similar to that being investigated for converting sunlight into interior lighting for buildings.

Rather than relying on the conventional technique of converting solar energy into electricity and then using that to power interior lighting systems, the ORNL scientists have come up with a technique that separates the visible portion of the light spectrum and uses it directly for indoor lighting.

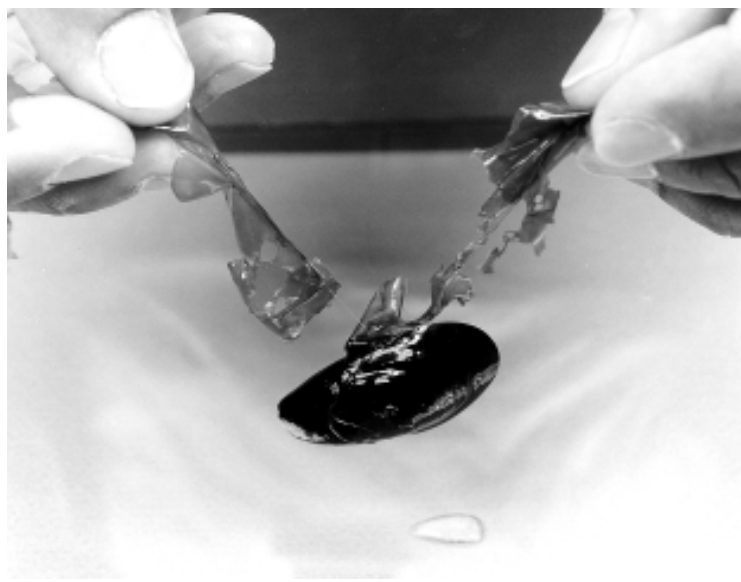
ORNL's experimental system, being developed with the assistance of industrial partners, uses innovative roof-mounted, twin-axis, tracking concentrators that separate the visible and infrared portions of solar radiation. Optical fibers transport and distribute the visible light to building interiors.

See 'Hybrid Lighting' on page 14

Natural solution: There's nothing like a mussel for a sturdy grip

Molecular biologists at the U.S. Department of Energy's (DOE) Idaho National Engineering and Environmental Laboratory (INEEL) are cloning mussel genes to look for ways to economically produce large quantities of the substance that gives the shellfish their adhesive ability.

The INEEL scientists—aiding the U.S. military in the search for a strong, waterproof adhesive—went underwater, so to speak, to examine how the sea critters had been clinging to rocks naturally throughout their existence. Of particular interest was the mussels' "feet," from which the small mollusks produce a natural adhesive that grips surfaces as well as any man-made glue.



To stay put, mussels secrete proteins along with a catalyst, which form into threads of natural "superglue" like these in about one minute. Scientists want to clone the adhesive.

A laboratory source for the glue is desired because of the prohibitive cost—not only in dollars but because it takes about 10,000 of the shellfish to produce just one gram of adhesive.

Sea water breaks down even the strongest of conventional adhesives, a concern not only to the Navy but industries involved in building and repairing ships, the medical establishment and any other agencies concerned with the deterioration of materials exposed to moisture. Mussels' feet have organs that secrete

See 'Natural Solution' on page 2

One person makes a big difference in energy use at Argonne-East

Sam Ambegaoker of Plant Facilities Services at Argonne National Laboratory East (left), is shown receiving the 1999 U.S. Department of Energy (DOE) Energy Efficiency Award from Assistant Secretary for Energy Efficiency and Renewable Energy Dan Reicher at DOE Headquarters. He also received the 1999 Federal Energy and Water Management Award.

Ambegaoker, now retired, won these awards for his efforts in reducing the amount of energy used at Argonne-East over the past 22 years. During that time, he has guided approximately three dozen major energy-efficiency projects at the Laboratory. One success: Ambegaoker helped push through the optimization of energy used by Argonne-East's heating, ventilation, and air-conditioning (HVAC) systems through system redesign and modifications from pneumatic to direct digital controls. He also masterminded reductions in the Laboratory's electrical energy consumption by retrofitting lighting fixtures, installing electronic ballasts in fluorescent lighting, and replacing conventional lamps with higher efficiency lamps to provide the same lighting levels with less power consumption.

Ambegaoker's energy reduction efforts during his years at



Argonne saved more than 62 million pounds in steam supply annually and have lowered the Laboratory's electrical demand by 17.4 million kilowatt-hours each year.

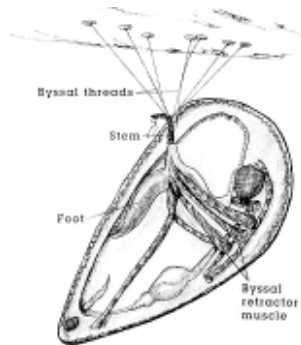
Contact Keith Trychta, Argonne-East, 630-252-1476 or ktrychta@anl.gov

From 'Natural Solution' on page 1

proteins along with a catalyst. It takes about one minute for the viscous substance to harden into a thread, attaching itself to a new surface. The threads enable mussels to anchor to rocks and pilings in turbulent areas where food and oxygen are more abundant. They are also known to attach to the hulls of ships, increasing drag and therefore decreasing a vessel's mobility. Understanding how the mussels attach themselves to ships is expected to lead to measures to prevent it.

Researchers at INEEL, collaborating with scientists at the University of California/Santa Barbara, are focusing on identifying five proteins that go into the thread makeup that constitutes the "glue." Understanding these proteins will point the way to cloning the material. "With a method of mass producing (the threads) through cloning," says Frank Roberto, molecular biologist at the INEEL, "companies like 3M and AlliedSignal will be able to test the natural super glue on their products." Otherwise, Roberto added, it would take about a million mussels just to provide enough material to begin tests "and that's impossible."

"Mussel glue" doesn't need high temperatures to activate its cementing qualities as do conventional waterproof glues. Also, since it's a natural product, unlike the standard petroleum and tar-based glues, it's environmentally safe, Roberto said.

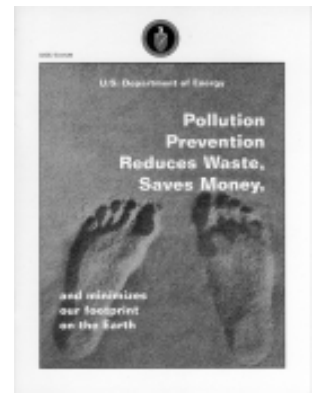


Adhesive produced in the mussel's foot forms the byssal threads that the mollusk uses to attach itself to surfaces.

Contact Teri Ehresman, INEEL, 208-526-7785 or ehr@inel.gov

DOE outreach document 'Minimizes Our Footprints'

The Department of Energy (DOE), assisted by the DOE Oakland Operations Office (OAK), has released a new public outreach document, *Pollution Prevention Reduces Waste, Saves Money, and minimizes our footprint on the Earth*. Secretary of Energy Bill Richardson said in a foreword to the new document, "DOE is committed to continue preventing pollution at the source while achieving environmentally and economically sustainable research operations and leadership in science and technology. . . It is clear the Department can lower the future operating costs and liabilities of its mission activities by incorporating pollution prevention into the design and modification of all facilities and programs." The outreach document includes a comment card for feedback from readers on the Department's pollution prevention efforts. "The document explains to the public the value and benefits of pollution prevention in a constructive, easy to understand manner," said Dan Reicher, Assistant Secretary for Energy Efficiency and Renewable Energy and DOE Environmental Executive. "It effectively conveys the significant accomplishments that pollution prevention has achieved for the Department." The 16-page document is for sale to the public through the Government Printing Office.

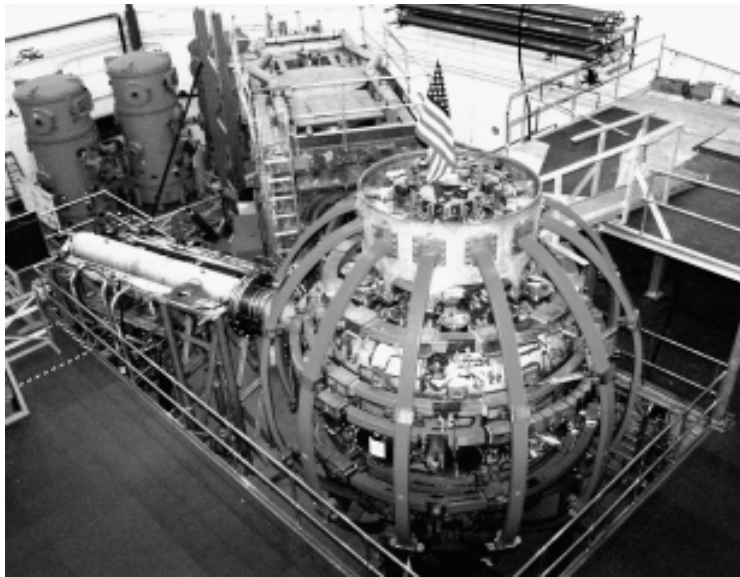


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NSTX produces record plasma current ahead of schedule

The National Spherical Torus Experiment (NSTX) at the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) beat a previous record for a spherical torus device by producing a 1 million ampere plasma current.

Producing this plasma current could lead to the development of smaller, more economical fusion power plants and sets the



The National Spherical Torus Experiment at Princeton Plasma Physics Laboratory could be a prototype for fusion power plants.

stage for PPPL to create and study plasma conditions relevant to the production of fusion energy.

The NSTX experiment met the technical milestone nine months ahead of schedule, noted Energy Secretary Bill Richardson. "We can now begin the scientific investigations that the machine is designed to do."

The previous record plasma current ever produced in a spherical torus device is 310,000 amperes, achieved in a smaller spherical torus device called START (Small Tight Aspect Ratio Tokamak) built by Culham Fusion Laboratory of Great Britain.

At PPPL, physicists use a magnetic field to confine hot, ionized gas, called plasma, for research on fusion. Scientists hope eventually to use the energy produced by fusion for the production of electricity.

Compared to fossil fuels and fission now used in commercial power plants, fusion would have distinct advantages, including an inexhaustible fuel supply, no contribution to acid rain or global warming, and inherent safety features, with minimal production of waste.

NSTX Program Director Martin Peng said, "The goals of the next few years of research on NSTX are to produce high-quality scientific results and excellent plasma performance. If successful, NSTX will have an impact on the design of future devices. These machines would extend the temperatures, densities, and other plasma parameters to the levels necessary for fusion energy production."

Contact Anthony De Meo, 609-243-2755 or ademeo@pppl.gov

White House energy bill trimmed

A "greening of the White House" initiative has saved taxpayers nearly \$1.4 million since 1993, according to an administration report released last December. Savings from the energy-efficiency measures, now running at about \$300,000 a year, were achieved through more efficient lighting, heating and air conditioning and other modifications.

"This has been his baby from the beginning," said Roger Ballantine, President Clinton's deputy assistant for environmental initiatives. Clinton inaugurated the White House effort in 1993. According to *The Washington Post* (Dec. 2, 1999), the energy-efficiency strategy developed by architects, Potomac Electric Power Co. experts, and Federal agency officials included replacing incandescent table lamp bulbs with compact fluorescent bulbs, taking advantage of natural light, and ensuring that electric lights got turned off when not in use. The team also installed a new heating and air conditioning system in the executive residence, put new insulation on pipes and installed high-efficiency refrigerators in the White House kitchen. The executive mansion's staff also took part in pilot programs to test alternatively powered vehicles.

U.S. wind energy capacity on the rise

Two states, Iowa and Minnesota, account for more than half the increased wind energy capacity generated in the U.S. — almost 900 megawatts. This brings total domestic wind energy to more than 2,500 megawatts, according to the American Wind Energy Association. Four factors spurred this growth: supportive state policies, "green power" programs, the wind energy Production Tax Credit, and decreasing production costs. Minnesota in particular has mandated that its largest utility install 425 MW of wind capacity by 2002 in return for the right to store nuclear waste from its power plants within the state.

Fusion: Safer nuclear energy?

Matter is converted into energy in the interior of the sun and other stars by a process called fusion, a joining of the nuclei of "light" atoms to form heavier elements. Light nuclei, such as hydrogen isotopes, release energy when fused. Effective energy-producing fusions require that gas from a combination of the isotopes of hydrogen—deuterium and tritium—be heated to very high temperatures (100 million degrees centigrade) and confined for at least one second. One way to achieve these conditions is to use magnetic confinement. One of the most promising designs for this magnetic process is called a *tokamak*—a Russian word for a torus-shaped magnetic chamber. Fusion proponents say the process has very good inherent safety qualities; there are no chain reactions and the worst possible accident originating in a fusion power station could not breach the confinement. Plus, proponents say, any releases that did occur would decay very rapidly and would not require the evacuation of nearby populations.

For additional information on plasmas, fusion, NSTX and the near-term applications of plasma science and technology at PPPL, go to <http://www.pppl.gov>

What motivates military housing residents to save energy?

Results of Department of Energy-funded studies at two U.S. military sites have demonstrated the feasibility of tailored, research-based strategies to promote energy conservation in military family housing. These families do not pay their own energy bills, so motivation must be non-economic.

The two campaigns focused on motivating behavior changes by the residents themselves, emphasizing no-cost and low-cost actions. At Fort Lewis, Washington, the project ran through the end of fiscal year 1999.

At Yuma Marine Corps Air Station, Arizona, the campaign began in July 1999 and ends this fiscal year.

At both sites, specific, customized actions were targeted based on communication and social science theory, related studies, and recommendations from base officials and resident groups. Energy-saving efforts ranged widely from articles and fliers and reminders on electronic billboards to videotaped behaviors modeled by residents themselves, children's programs, and written notices of observed energy-inefficient behaviors.

The program's aims were to raise awareness, provide links between energy-efficient behaviors and lifestyle benefits, and to appeal to existing values of patriotism, environmentalism, and competition among housing communities. Results were evaluated in two ways: through energy-use data and through surveys to determine the extent to which behavior changes by residents contributed to the savings.

At Fort Lewis, changes in energy-related behaviors resulted in 10 percent weather-corrected energy savings in family housing, amounting to the equivalent of \$130,387 saved. Final results from Yuma are still being calculated, though the Housing Manager has reported that the energy-efficiency promotion activities led to a transfer of \$50,000 from the energy account to another account.

The larger goal of long-lasting behavior changes in energy users is difficult to evaluate, but 92 percent of respondents to the post-campaign surveys at Fort Lewis reported that they had made at least one behavioral change to become more energy efficient.

Several institutional issues are common to both military sites. First, because funding is obligated within strict categories, savings in energy costs cannot (without high-level approval from Marine Corps Headquarters) be used for rewards/incentives. At Fort Lewis, the commander had thought he could provide community rewards and then had to renege on his promise. Second, military housing is a jealously guarded benefit of military service; placing conditions on resident families is seen as risky. Third, many military bases (including Yuma) are being evaluated for privatization, so control of any energy-efficiency programs may be delegated to contractors.

The studies were supported under DOE's Federal Energy Management Program and implemented by staff at Pacific Northwest National Laboratory and personnel at the military installations.

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Surfactant use could turn chemical industry green

A new approach in the chemical industry may utilize surfactants to disperse insoluble substances in carbon dioxide (CO_2). The successful substitution of CO_2 for noxious industrial solvents holds great promise for the \$368 billion-per-year domestic chemical industry, but the insolubility of many substances in CO_2 has restricted the use of the "green" technology.

The U.S. chemical industry utilizes nearly 3.8 million tons of liquid organic solvents yearly, most of which are hazardous to our health, safety, and/or environment. Solvents are necessary as media for chemical reactions, chemical separations, and cleaning throughout the industry. Despite the largest investment in pollution prevention among all industrial sectors, the chemical industry is still one of the largest polluters in the U.S. Thus, the industry has sought alternatives to noxious organic solvents, and CO_2 is one of the prime candidates as a solvent substitute.

CO_2 is relatively inert, non-toxic, safe, and inexpensive, and is produced in large excess as a by-product by other processes, so its use as an industrial solvent would not add to environmental problems. However, it is not a perfect solvent for all industrial applications. Water and hydrophilic substances (including most biological chemicals) have very low solubility in CO_2 ; likewise, most polymers are virtually insoluble. So, without a means to disperse such substances in CO_2 , opportunities for solvent substitution would be severely limited.

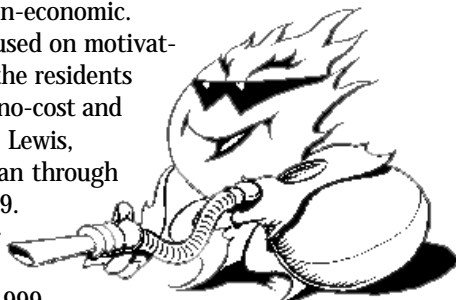
The traditional way in which industry has dispersed one insoluble fluid in another is through the use of surfactants or detergents. To take a familiar example, detergents disperse oily substances in water so that we can wash our dishes. Other surfactants affect materials in different ways. U.S. Department of Energy (DOE) research to broaden the applications of surfactants has focused on supercritical solvents—solvents created under extreme heat and pressure—which have properties that can be varied from liquid-like properties to gas-like properties and can offer varying advantages.

The pursuit of CO_2 -based green chemistry has benefitted from the basic research facilities and expertise of several research programs sponsored by the DOE Office of Basic Energy Sciences (BES)—at Pacific Northwest National Laboratory (PNNL) with Richard Smith and John Fulton, at the University of Texas with Keith Johnston, and at Oak Ridge National Laboratory (ORNL) with George Wignall and Hank Cochran.

The DOE surfactant research has already led to commercial applications, such as innovations in dry cleaning technology turned up by Micell Technologies, Inc. and in CO_2 -based industrial production of Teflon polymers by E. I. DuPont de Nemours and Company. The success of the new technology is a tribute to the effectiveness of such partnerships in basic research and applied research and development involving universities, National Laboratories, and industry, facilitated by the DOE.

The DOE surfactant research program received the Presidential Green Chemistry Challenge Award in 1997. For its important contributions, PNNL received a 1998 R&D 100 Award from Research and Development Magazine and the Federal Laboratory Consortium for Technology Transfer's 1999 Award for Excellence.

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"Energy Bandit" reminds military families to conserve.

U.S. Department of Energy
16th Biannual Pollution Prevention
Hands-On Training
Technology Workshop

Berkeley, California
February 15-17, 2000



Berkeley workshop pushes sustainability as next step beyond pollution prevention

Blustery California wet-season weather did not dampen the spirit of the U.S. Department of Energy (DOE) Defense Programs' 16th Biannual Pollution Prevention Hands-On Training Technology Workshop. The three-day discourse "Celebrating Sustainability" began with a registration/reception on a breezy Valentine's Day Monday evening in the conference headquarters at the Berkeley Marina Radisson, literally in sight of local host Lawrence Berkeley National Laboratory on the hillside above.

It would seem almost counterintuitive for a DOE workshop to center around "Surpassing Pollution Prevention" with sustainability, when much in the context of eliminating waste generation remains to be done throughout the DOE complex. But participants in the Berkeley gathering might have surprised themselves with their enthusiasm for the sustainable practices that they learned about through hands-on activities, visits to local industries, and formal and informal exchanges of information.

"I think 'pollution prevention' has failed," said workshop organizer John Marchetti (DOE Defense Programs) in a wake-up call to the workshop's opening session on Tuesday morning. "The success we've had is small compared to the opportunities we've had to succeed . . . Why? It's a failure to change the (DOE) culture . . . The environment is not a competing interest with our mission—it's the playing field where all the interests meet."

Marchetti chronicled the "natural development" over the past two decades in industry from the concept of waste minimization to pollution prevention to environmental management systems to design for environment to sustainable development, using the United Nations 1987 definition of sustainability as "meeting today's needs without compromising the needs of future generations."

Workshop organizer Elizabeth McPherson (McPherson Environmental Resources, Inc.) coached participants in the real-time, real-life game of "Wasted," challenging each person to save *all* waste (other than sanitary) that he or she would generate over the next 48 hours. Each player was equipped with containers for recyclable and non-recyclable wastes to be weighed at the workshop's final session. Topic area groups would combine their members' waste poundage for the two days, with credits for recycling and other waste avoidances and prizes for the group with the least amount of waste generated as well as individual awards for waste-saving innovations, strategies, and initiatives. This deceptively simple exercise would prove to be one of the most revealing hands-on activities of the workshop in terms of raising the individual's awareness of the sustainability of his or her daily habits.

continued on page 6

*Surpassing Pollution Prevention. . .
Celebrating Sustainability*

continued from page 5

Gil Friend (Natural Logic, Inc.), systems ecologist and business strategist, led the workshop in exploring ways to successfully and economically integrate what he termed Environmental Quality and Efficiency (EQE) into DOE operations. Friend is a senior instructor in The Natural Step, a framework of scientifically based principles for guiding society toward sustainability. Demonstrating how the limits of the natural cycle, “a system closed to matter and open to energy,” have direct economic consequences, in particular leading to our current “unsustainable society,” Friend outlined the four system conditions that comprise The Natural Step:

- *Substances from the earth's crust must not systematically increase in the biosphere.* For example, Friend noted, more than half the copper in the world is “above ground” and 95 percent of arsenic in the U.S. is now in wood preservatives. With current methods, 20 tons of materials are extracted from the earth to make a wedding ring, 30-40 tons for a laptop computer, not an efficient ratio of product to non-product.
- *Substances produced by society must not systematically increase in nature.* This means substances must not be produced faster than they can be broken down and reintegrated into the natural cycle. Friend showed a list of over 150 man-made chemicals which were found to be present in a recent bioassay of mother's milk from New Jersey.
- *The physical basis for the productivity and diversity of nature must not be systematically deteriorated.* Sunlight, captured and transformed by photosynthesis, is the fundamental “quality engine” for life on earth. The bad news: nearly half of all Net Primary Productivity is used by human society ... at a time when 20 percent of us use 80 percent of earth's resources. The good news: industrial society's energy budget is only 1/13,000 of Earth's solar budget
- *There must be fair and efficient use of resources with respect to meeting human needs.* Basic human needs must be met in the most resource-efficient ways possible. Friend again cited major industries who have gone beyond pollution prevention to embrace sustainability as their method of doing business. Electrolux produces energy efficient dishwashers and clothes washers “not because we're a ‘green’ company,” said a company spokesman, but as a new approach to profitability and moving beyond regulation. AssiDomän AB, one of the world's largest forestry, pulp and paper companies, has begun to shift from the big clear cuts and other industry practices of 10-15 years ago to “site-adapted” forestry. “Their ‘heavily cut-over’ areas look like park land,” Friend said, “and their profits are up 56 percent per acre.” ASG Transport & Logistics has begun measuring its profits per liter of fuel, de-emphasizing sheer volume of goods moved.

Friend shared these sobering facts with the workshop: “Our economy isn't as efficient as we like to think. Our ratio of product to non-product is only 1:20” — about five percent efficient. Six months later, 80 percent of production is waste, bringing our materials efficiency down to 1.2 percent.” He introduced workshop participants to new conceptual and software tools to measure and coordinate economic and environmental progress: “What gets measured gets done, so what should

you measure?” (For more information, go to www.natlogic.com, where you can find software demos, and also access Friend's syndicated column “The New Bottom Line.”)

Gerald Kotas (DOE Golden Field Office) addressed the workshop on opportunities to move from pollution prevention to sustainable development through energy efficiency and the use of renewable energy sources. “Energy use today is the number one cause of environmental damage,” Kotas said, “and electric generation is the world's chief polluter.” Every quad of energy eliminated from industrial energy use would be a savings of 17-19 million metric tons of carbon—roughly equivalent to the annual carbon storage of 20 million acres of forest, removing from the road 15 million cars traveling 11,000 miles at 20 miles per gallon, or eliminating 8.5 million households served by coal-fired electrical generation.

Kotas said that by 2010, renewable energy policies resulting from electric industry restructuring in 13 states may lead to development of over 4,200 megawatts of new renewable electrical generation in addition to the 7,500 megawatts of existing renewable genera-

tion. In California, for example, 30 to 50 percent of residential customers chose “green” power initially; in Pennsylvania, about 12 percent (450,000) customers have switched to renewable utility sources.

There are many opportunities for DOE facilities to purchase renewable energy, Kotas said, and there are creative financing alternatives available for those facilities that ask for energy from renewable sources from their utilities. He discussed federal initiatives that are “jump-starting” renewable energy technologies, including Executive Order 13123, which mandates among other things a 25 percent reduction in energy use in DOE laboratory and production facilities by 2010.

Kotas related several cases of the profitable use of renewable energy, including Fetzer Vineyards in Hopland, Calif., the New Belgium Brewery in Fort Collins, Colo., a Federal Express distribution center in Littleton, Colo., Toyota Motor Sales' California facilities, and Interface, Inc. carpet manufacturing. Another example is DuPont's corporate goal to reduce greenhouse gas emissions by 65 percent, using 1990 as a baseline, by holding energy use flat and using renewable energy for 10 percent of its global energy consumption.

Kotas urged incorporating sustainable principles into all types of social/industrial planning, using a “systems” approach. “Sustainable development is real, beneficial, cost-effective and growing,” he said. “A community is more effective when it deals with itself as a system rather than as a series of unrelated crises.” U.S. industries today use 36 percent of the national energy and spend \$45 billion a year to control pollution, disposing of a ton of waste per week to support a single U.S. consumer, he told the workshop, and thus there are many opportunities to increase resource efficiency and at the same time improve our productivity and global competitiveness.

Kotas gave several illustrations of how planning sustainability into buildings, transportation, and energy use can increase production and promote good health while saving money and stopping environmental degradation. “Pollution prevention helps measure progress toward sustainability,” he said. He urged DOE workshop attendees to develop ideas on how sustainable development can address their pollution prevention needs, and to identify and to contact individuals and organizations active in

“The environment is not a competing interest with our mission—it's the playing field where all the interests meet.”

— John Marchetti (DOE Defense Programs)

sustainability. “Combining energy efficiency, pollution prevention, and sustainability yields better results, leverages scarce resources, creates a community-wide vision for preventing pollution, and develops innovative partnerships,” Kotas concluded.

Workshop facilitators Friend and Kotas then led what began as a question-and-answer session on the principles of sustainability that they had put forth to the group in the day’s presentations. The dialogue took a decidedly DOE turn, and many complex-wide and site-specific problems were aired. The general trend of the conversation was concern with how to move the DOE organizational culture toward sustainability as an integral part of mission, rather than having sustainable concepts regarded as the step-children of mission operations. Afterward, more than one workshop participant stated that this had been the most exciting part of the day, as opinions were many and varied and few participants were shy in stating their convictions and relating experiences with the resistant culture. To close the first day’s activities, topic area groups caucused to prepare



Gerald Kotas, left, and Gil Friend facilitate a lively discussion at the Defense Programs’ workshop in Berkeley.

questions for their local hosts during the site tours the next day.

Following a day of group visits with various East Bay industry hosts and an evening of comparing notes, on Thursday morning the workshop reconvened for topic area groups to make informal

presentations on sustainable practices which they had observed during their site tours (see pp. 7-13).

“Wasted” contest award winners were chosen by a show of hands after each group had weighed and tallied its accumulated waste — a very compelling activity which filled several recycle containers and a trash can or two. Some individuals and groups were big consumers and some were incredibly resourceful in their waste reduction strategies, but all were astonished by the results. John Marchetti closed the meeting with an

allegory of how, as agents of sustainability, we can be powerful like a clear stream rushing over rocks or stagnant like a murky pool.

Contact John Marchetti, 301-903-5003 or John.Marchetti@ns.doe.gov and Elizabeth McPherson, 423-543-5422 or mers@usit.net

Tiny Emeryville is a world giant in brownfields redevelopment

Brownfields group visitors to the City of Emeryville, Calif., from the Defense Programs’ workshop found an award-winning approach to redevelopment in the tiny (one mile square) municipality.

After it lost many of its supporting but polluting heavy industries in the 1970s and 80s, Emeryville began to take control of its own destiny. The City sought and won a Brownfields Pilot Project grant from the U.S. Environmental Protection Agency, involving its citizens, businesses, developers, and regulatory agencies in reclamation efforts and turning its legacy of environmental liabilities into real estate assets.

Since groundwater contamination from past practices is the biggest concern, Ignacio Dayrit (Emeryville Redevelopment Agency) told the Brownfields group, the City is gradually assuming citywide monitoring and cleanup of contamination in the shallow-water aquifer underlying the town. Emeryville is working with state, regional, and county regulators to ease the regulatory burden on property buyers and owners by direct City regulation of smaller and less polluted sites. “If the City doesn’t take the lead, no one will,” Dayrit said.

Brownfields site assessments and remediation are more cost-effective for larger sites, and many of Emeryville’s success stories are commercial reclamations on a grand scale. But, said City Councilwoman Nora Davis, “We’re a mixed-use city. We’re trying to bring back population density to create urban vitality.” The City is promoting residential and small business development through a program called Capital Incentives for Emeryville’s Redevelopment

and Remediation (CIERRA), which awards grants of matching funds for smaller site assessments and remedial plans and low or no-interest loans for cleanup.

A masterwork of Emeryville’s redevelopment-friendly approach is the City’s “One-Stop Shop” geographic information system (www.ci.emeryville.ca.us/oss.htm), where prospective buyers can access the environmental, planning, zoning, and ownership status of every parcel of land within the City limits. The unique ArcView™ application won in the environmental category of the 1999 Stockholm Global Challenge for innovations in information technology, over finalists from Stockholm, Moscow, and Bremen, Germany.

Dayrit accompanied the Brownfields group on a tour of the Chiron Corporation Life Sciences Center, state-of-the-art, 286,000 square-foot biotechnology



Brownfields group tours the Chiron Corporation Life Sciences Center, constructed on a former brownfield site.

laboratories recently built on the site of a past electrical transformer facility. The building, designed by Ricardo Legorreta, features not only his signature purple and yellow colors throughout, but also architectural innovations in daylighting and energy management. Chiron, founded locally, is making a \$95 million dollar investment in the redevelopment of 25 acres over the next 20 years, and like most redevelopers, is deeply vested in promoting a sustainable future for Emeryville. “You have to have the political will,” said Councilwoman Davis.

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Sustainable construction makes big inroads in Alameda County

Communication, innovation, and opportunity—that's what's going on in the fast-growing field of sustainable design and construction. And as the Defense Programs workshop Sustainable Construction group found, Alameda County, Calif. is helping to set the pace for local builders and designers.

The group began their busy day early at workshop headquarters with a discussion of earth-friendly materials, reclaimed and recycled woods, and energy-saving and environmentally sensitive techniques for home construction and renovation, led by local contractor Mark Quigley (Environmental Builders). Next, they accompanied the Community Outreach group to the Alameda County Waste Management Authority.

The Authority's Source Reduction and Recycling Board is building a resource pool to assist local builders in recycling construction and demolition debris, utilizing green methods for deconstruction and construction, and purchasing green materials. Driven by a county ordinance requiring building owners to reduce construction and demolition waste, they provide resources such as the publication "Builder's Guide to Reuse and Recycling," access to local architects and contractors knowledgeable in green construction techniques, and grants to fund innovative ideas for deconstruction and green building design.

The workshop group then traveled to the Port of Oakland, which has partnered with the non-profit Youth Employment Partnership (YEP), Inc. for the deconstruction of nine large warehouses in preparation for the Port's expansion. These World War Two-era Navy supply warehouses, about three acres each in area, are being deconstructed by "at-risk" youth employed by YEP. The deconstruction laborers receive valuable training for the booming local construction workplace, where the supply of labor is short.

Based on program statistics, 75 percent of YEP participants will be employed in construction after completing the 500-hour training program; 50 percent are women. The program is limited to youth who do not have a GED or high school diploma, have been on welfare for an extended period, and are Oakland residents. YEP helps the trainees gain valuable skills, builds worker confidence, and assists them in mundane but necessary tasks such as getting a driver's license.

From a project management perspective, YEP's Chris Thomas told the workshop group, the warehouse deconstruction is rewarding but difficult. The biggest challenge is to meet the Port's demolition schedule while running a training program; then there is the problem of storing the salvaged wood until a buyer offers the right price. Thomas estimated that the salvaged wood from all nine warehouses, which includes old-growth redwood and Douglas fir, equates to 600 acres of forest. Based on previous YEP statistics, only 5 percent of the entire building waste from each warehouse will end up in the landfill.

The workshop group made another visit, this one to the City of Oakland's brand new Green Building Resource Center, strategically located next to the Building Permits Office to make it a one-stop shop for contractors and designers to acquire the latest information on new materials and methods for sustainable design and construction. The group toured the Oakland City Hall and an adjacent administration building. City Hall was built in the early 1900s and renovated after the 1989 earthquake. Due to the building's historical significance, some energy-efficient upgrades such as thermal coatings on the exterior glass and double-paned windows could not be implemented; however, several energy efficient improvements were made, including right-sizing the

HVAC load prior to upgrading the chillers, incorporating daylighting, compact fluorescent retrofits, and electronic ballasts. In the near future, the City plans to incorporate into City Hall operations certified sustainable wood products, recycled materials, and an energy package that is 100 percent from renewable sources.

The Sustainable Construction group made another stop at the City of Berkeley's Green Resource Center, filled with information, materials, and techniques on sustainability as it relates to the "built-environment," and ended the day with another discussion led by green contractor

Quigley. He reminded the group that there may be some "compromises" in sustainable construction materials, such as the use of adhesives in the recycled wood products he displayed. But Quigley emphasized that consumption of wood fiber must be reduced, as the supply is rapidly running out.

"We learned that in large construction projects with long lead times, it is an enormous challenge to keep specifications current in this rapidly changing field of sustainable construction," wrote group leader Karin King of the Department of Energy Oakland Area Office. "Communication is key among all affected parties—the building or property owner, permitting agency, designer, general contractor, suppliers and distributors, and subcontractors and trades."

"We saw great innovation in the Port of Oakland deconstruction project and the work of local contractors like Environmental Builders," King continued. "There is also tremendous opportunity for them to capitalize on their valuable experience and knowledge in a field that lacks competition for services and is filled with new materials that need to be tested in the marketplace."

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For more information, go to <http://www.environmentalbuilders.com> and <http://www.stopwaste.org>



The Sustainable Construction group observes the labor-intensive task of "de-nailing" valuable lumber from old-growth forests at a Port of Oakland deconstruction project.

Celebrating sustainability: Surpassing P2 with E2 at PG&E

The Defense Programs' workshop Energy Efficiency (E2) field trip to the Pacific Gas and Electric (PG&E) Pacific Energy Center in San Francisco was an excellent example of how an organization can set a BHAG (Big Hairy Audacious Goal) and meet it.

In 1992, PG&E decided that it would fill its customers' projected need for an additional 2,500 megawatts (MW) of electrical power by the year 2000 with both sound environmental policy and sound business practices. The power utility accomplished this with "negawatts" — 2,500 MW of generation capacity that the utility felt already existed or were potential in their customers' facilities and facility designs, which could be manifested through application of E2 technology.

These negawatts were indeed generated through PG&E's proactive push to identify and implement E2 measures in every available application. Not only was the BHAG achieved, but the results also yielded pollution prevention (P2) benefits. As a result of the E2 which PG&E helped its customers quantify and achieve, the utility gained "new" capacity up to 2,500 MW and also avoided building new power plants to supply that amount of electrical power, freeing up capital that it can use for other purposes.

Plus, every 1,000 kilowatt-hours of power not generated eliminates the emission of 1,600 pounds of CO₂, 11.6 pounds of SO₂, and 6.16 pounds of NO_x, based on the U.S. national average. Since 2,500 MW equals 2,500,000 kW, each one of the above reduced air emission values would be multiplied by a factor of 2,500 for every hour that the 2,500 MW is not generated. Now, that's pollution prevention!

One of the E2 practices that PG&E encourages its customers to undertake is "daylighting"— basically using sunlight during daytime hours to illuminate indoor spaces. In daylighting design sessions at the Pacific Energy Center, the E2 group learned that, besides saving energy and reducing pollution, statistics show that natural daylighting improves employee health, reduces

sick days, and improves productivity because people feel better at work; students in daylighted schools learn better and retail

sales are 40 percent higher in daylighted areas of stores. A good example supporting these statistics is the Federal government implementation of daylighting in the Las Vegas Post Office.

For those on the West Coast, PG&E sponsors 70 to 100 classes each year in daylighting, window selection for coatings and energy savings, heliodon use, and HVAC, all open to the public at no charge. The utility also opens its electric lighting laboratory to the public, and has an energy measurement lending library for hi-tech tools that measure lighting levels, occupancy time, air and water flow, and CO₂ levels, as well as data loggers for

temperature, relative humidity, current BTUs, and non-contact temperature. These tools, whose cost could inhibit energy auditing in some projects, are loaned at no charge to assist PG&E customers in E2 site characterizations. PG&E's E2 knowledge base can also be accessed on-line at <http://www.pge.com/pec/>.

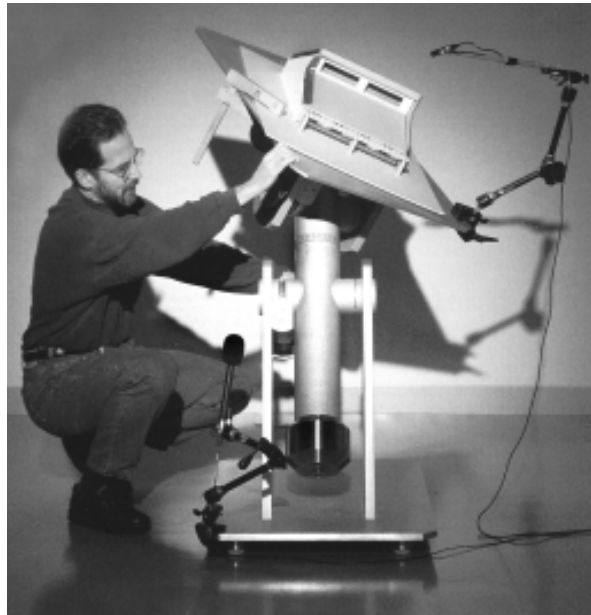
The workshop group's hosts reminded them that E2 codes must now be followed in the construction of new facilities. In California, for example, Title 24 mandates that you meet certain

minimum requirements for E2; Federal facilities must meet 10CFR434 requirements. Based on their experiences at PG&E and in their Department of Energy work, the workshop group feels that E2 will yield tangible environmental and economic benefits in many, if not all, projects.

The E2 group's major suggestion to the workshop and other DOE personnel is that when an E2 project is proposed, *all* of the benefits should be considered, quantified, and qualified. Also, the E2 group felt that all Department of Energy laboratories and production facilities should 'walk the talk' of the Secretarial leadership goals (*Pollution Prevention and Energy Efficiency Goals for FY2000 and Beyond*) announced at the DOE P2 Conference in November.



Energy Efficiency group members (minus their leader, Jerry Kotas), from left, Ralph Wrons, Tom McGeachen, Radisson Hotel van driver, Elizabeth McPherson, and Tom Rambur, traveled to the Pacific Energy Center in San Francisco.



This heliodon is available to Pacific Gas & Electric customers who want to determine how sunlight will strike their buildings at any given time on any day of the year. (Photo courtesy of Pacific Gas & Electric)

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Metals group closes loop: Zero water discharge at Gold Seal Plating

Zero discharge — that's what sustainable business is all about. But is it economical? How does it affect quality? Gold Seal Plating, a small job shop in Oakland, Calif. showed the Defense Programs' workshop Metals group how zero discharge paid off big-time for them.

Gold Seal provides nickel, copper, silver, and gold plating of jewelry and flexible circuits in two shifts of about 20 employees each in its unassuming plant in an industrial section of Oakland. There, workers perform rack and barrel plating and operate both manual and automatic plating lines.

Tour host and Gold Seal President Gary Spencer told the workshop group that many of the pollution prevention awards on the plant walls came primarily from the company's switchover to a closed-loop ion exchange rinsewater treatment system. Gold

Seal formerly treated its metal-containing rinsewaters through an on-site, traditional neutralization/precipitation/flocculation system. The company treated over 2 million gallons of hazardous rinsewater each year, bought as potable water from the City and discharged to the Oakland sewer system, and generated over 70,000 pounds of metal hydroxide sludge, sent off-site for metals recovery.

The switch to closed-loop system came about as a result of a series of source reduction measures the company undertook that ultimately reduced rinsewater flowrates from 15 to six gallons per minute and metals loading into the rinsewater by 90 percent. There was some concern about final product quality, however: lower flow rates mean more contaminated rinses, increasing the chances for defective plating.

Gold Seal wanted to improve rinsewater quality without requiring more city water, additional wastewater treatment, and increased discharge to the city sewer. To do this, and to close the loop on its rinsewater system and achieve zero wastewater discharge, the answer was ion exchange. Gold Seal's system works like this:

- Hazardous rinsewater from plating operations is carbon-filtered to remove organic by-products of the plating process. Rinsewaters then proceed through cation exchange beds where the dissolved, positive-charged ions (nickel, copper, gold, silver, sodium, etc.) are exchanged with hydrogen, then through anion exchange beds where the negative-charged ions (sulfates, chlorides, cyanides, etc.) are exchanged with hydroxide.
- A final "polishing" bed improves water quality, and the deionized water is recycled to a holding tank which replenishes the spray

tanks and rinsing baths as needed. An ultraviolet light on the holding tank destroys any surfactants or organics left in the treated water and helps eliminate the buildup of bacteria in the tanks. (A recent innovation shown to the workshop group was a switch from white to black plastic holding tanks to further reduce bacterial buildup and reduce loading on the ultraviolet system.)

- The ion exchange beds are regenerated every six hours of operation, and the small amount of aqueous waste from the regeneration process is evaporated to achieve zero water discharge. Sludge generated through the ion-exchange process is less than half of that from a precipitation system.

Improving the rinsewater quality with deionization, Spencer said, effectively doubled the flowrate and improved the quality of Gold Seal's finishes. The ion exchange system

also has the advantage of lower operating costs. The equipment cost is high for a small company like Gold Seal, Spencer told the workshop group, but for his company that cost was recoverable over a two and a half year period, while the costs of annual permits, water, sewer, tests, and fines for

occasional discharge violations simply added to the cost of the precipitation system, despite its lower initial cost. Gold Seal estimates its annual savings from the ion exchange system at over \$72,000, based on 1995 statistics.

Spencer showed the workshop group other successes, like spray rinsing over the hot plating tanks to reduce "drag-out," and how ultra-filtration in parts washing increased water recycle. "Plus, we're the 'white hats,'" Spencer said, "the 'good guys.'" He said that customer and community appreciation of Gold Seal's efforts toward zero discharge had helped business. The workshop group noted that Gold Seal's open-door approach and highly visible operation also definitely contributes to the plating company's success.

After leaving Gold Seal, the Metals group was treated to a tour of the Lawrence Berkeley National Laboratory's (LBNL) Building 77 Engineering Shops. To learn more about their numerous successful pollution preventing innovations, see the 3rd Quarter 1999 issue of *ESAVE*.

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For more information, go to <http://www.goldsealplating.com>



Ion exchange is at the center of the zero discharge rinsewater system at Gold Seal Plating in Oakland.



A Gold Seal employee spray rinses a plating job over the hot rinse tank.

Alameda County Waste Management Authority: "Do the rot thing."

Lessons are well-learned at the Alameda County Waste Management Authority, and not just by the Defense Programs' workshop Community Outreach group. As the Outreach group found out, the Authority's influence on its East Bay district relies not only on its excellent printed materials, videos, web site (www.stopwaste.org), and ads on TV, radio, and public transit, but also uses direct-contact programs to get each citizen involved in the most basic aspects of sustainability on a daily basis.

For example, the Authority sells home composting bins to Alameda County residents at a reduced price to encourage composting. In the long run, the diversion of compostable wastes from landfill disposal more than pays for the program, according to hosts Bruce Goddard and Wendy Sommer at the Authority's San Leandro headquarters. Since debris from building activities is often the biggest single component in any municipal waste stream, the Authority also works directly with the construction/deconstruction industry in a variety of programs (see Sustainable construction, p. 8).

An annual community-wide "Trash to Treasures" junk art competition puts the spotlight on the basic reusability of most discarded materials, but the Authority's most intensive outreach is to Alameda County's children. In-school programs promote the "Four Rs": Reduce, Reuse, Recycle, and Rot. The Authority underwrites programs that teach kids K-12 about source reduction and recycling and sponsors waste diversion competitions between schools. An Education Partnership program develops parent/teacher/student training on how to incorporate the Four Rs into daily life. Children are encouraged not to take cafeteria food if they do not want it. In schools where they are required by law to take it, they can put their excess food on a share table for other students; unused items are donated to the homeless.

"Rot" means compost, and Alameda County is big on composting. The Authority helps implement the state program called "A Garden in Every School," in which school kids are taught composting and plant a garden on which the compost is used; older students serve as interns and help younger students. The Authority provides free worm composting bins for interested schools; one school is currently composting its cafeteria's lunch preparation waste. Graduate-level continuing education in composting techniques is available to Alameda County teachers through the Authority.

The Outreach group traveled to the Davis Street Transfer Station, where recyclables and disposables for 11 of the County's cities are sorted. Not only do 32 trucks haul 25 tons each of garbage from there to the landfill, making four to five daily trips each, but the

Transfer Station houses seven interactive, museum-quality exhibits in a 1,500-square foot building, including "Close the Loop," and "The History of Garbage," with two classrooms for up to 65 students each.

The station hosts daily three-hour tours, offers after-school programs, and has a garden, using composted yard waste, with which the kids help.



Non-recyclables await a trip to the landfill in "The Pit" at the Davis Street Transfer Station.

The group's last stop was the Alameda County Computer Resource Center, a non-profit organization funded through grants from the Authority. According to the Center's director, James Burgett, excess computers are

donated by residents or by area companies such as Advanced Micro Devices, Kaiser Permanente, Cellular One, and Levi Strauss.

The Center's five employees make sure the computers work or else fix them, then give about 90 percent of the reusable computers to educational and non-profit organizations, economically disadvantaged individuals and developing countries. Though some of the donated computers are obsolete and would normally have been discarded as trash, the Center is looking at ways to make them

useful again. While the computers are being bench tested, they connect several of them together as a "super computer" and work at developing a technology to run them as a single networked system—one that is powerful and fast enough to perform the complex tasks required by schools and other high volume users. Though still in the development stage, they hope to share this technology with the recipients of their donated computers in the near future. By July 2000, they hope to have one of the top 500 supercomputers. Says director James Burgett, "obsolescence is merely a lack of imagination."



Group members are astounded at Alameda County's vast computer recycling effort.

If a computer is irreparable, they strip it of reusable parts, recycle its plastics and other recyclables, then try to find a market for what's left over. For example, 72-pin simms are reusable, but not 32-pin simms. The Center sells the 32-pin simms to a memory remanufacturer who resells them to Mattel. Burgett said, "If you get a talking Barbie, there's a good chance its memory is mine."

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Hyland Immuno stops pollution at the source through process change

The Defense Programs' workshop Source Reduction group traveled to Baxter Hyland Immuno in Hayward, Calif., a company which employs approximately 70 people engaged in the manufacture of therapeutic proteins used in the treatment of hemophilia and cancer. The Source Reduction group's first impression of Hyland Immuno was the many proudly displayed awards for pollution prevention, including the State of California's WRAP [Waste Reduction Awards Program] award, which the company has won five times in the past seven years. The awards are thanks to company-wide commitment—source reduction goals permeate all levels and areas of the production process from design to packaging.

The Hayward plant's hazardous waste stream is comprised more than 90 percent of biohazardous wastes; non-hazardous wastes include Tyvek™, cardboard, comingled waste (paper, cardboard, plastic, aluminum, and tin), glass, and other solid wastes. Baxter's goals for the year 2005 (based on 1996 waste amounts) include achieving per-unit reductions in off-site disposal of 10 percent in hazardous wastes and 20 percent in non-regulated (municipal) wastes, plus a 10 percent reduction in the total usage of energy from electricity and fuels and a 10 percent reduction in packaging.

The first step in source reduction is process change. New projects at Hyland Immuno use fewer hazardous buffers (for example thimerosal), and new test methods are less hazardous because they use fewer chemicals; plus all processes are now designed to use less energy and generate less product-related wastes, mainly expired and excess subassemblies and media and excess ingredients and chemicals.

Hyland Immuno considers the products of its environmentally conscious manufacturing to be assets that often lead to a clear marketing advantage. "We know our environmentally friendly product gives us an edge over our competition," host Merete Miles told the workshop group. "This is especially true in European markets," she said, which are very reluctant to use products whose manufacture is associated in any way with PVC, lead, chromium, or mercury.

Hyland Immuno also source reduces through affirmative procurement: specifying that only approved chemicals may be purchased, flagging large quantities, questioning excessive packaging, and selecting suppliers who have good environmental records for recycled content, packaging, and take-back of excess materials. Supplier questionnaires and audits aid in this process.

A "chargeback" system for waste disposal and approved-only chemical use have resulted in the elimination of many hazardous wastes, including halogens and photo developer. The increased use of email, voice mail, public posting of memos, and LCDs for



Source Reduction group members: Charles Elliott, Jim Balkey, Steven Cassel, Al Karns, Chris Hammonds, and John Harley.

electronic presentations has contributed to the reduction of paper waste. Energy conservation efforts include a motor change-out program, use of proximity-sensor lighting, and participation in EPA's Green Lights program. Those materials which cannot be completely eliminated, such as metals, print cartridges, Tyvek™, and fluorescent bulbs, are recycled. Used computers are donated to a local high school.

All Hyland Immuno employees receive ES&H and energy conservation training. This includes contractors, engineers and janitors, who are required to buy products with recycled content. During construction and renovation projects, minimizing environmental impacts is a high priority, accomplished, for example, through contract management, eliminating the use of hazardous substances, and recycling materials whenever possible.

Miles pointed out some of Hyland Immuno's source reduction successes outside of process improvements. Liquid biohazardous wastes treated on-site are sent to a waste neutralization system, which relies on sodium hypochlorite to treat infectious waste. The neutralization system also neutralizes acidic or basic buffer waste streams with sodium hydroxide and sulfuric acid—a big success was cutting down on the amount of virgin materials required in the neutralization process. Also, she said, the chargeback system completely eliminated the use of hydrogen sulfide and mercury.

The comingled recycling program allowing comingling of paper, cardboard, plastic, aluminum, and tin for recycling really boosted the plant's recycling volume.

Aside from being a small facility with multiple small waste streams, Hyland Immuno still faces

source reduction challenges. For example, U.S. Food and Drug Administration (FDA) regulations require that certain processes use certain chemicals, such as cyanogen bromide, which is used as a catalyst when coupling proteins to beads. Sodium hydroxide, not environmentally friendly, is regarded by the FDA as the best cleaner for process equipment. Likewise, many required chemicals have short expiration dates, which creates waste even though the chemicals may still be useful or recyclable, and certain approved procedures require what may be excessive quantities of water. Furthermore, due to the nature of the biotech industry, there are limited opportunities for recycling of other materials, such as plastic bags. Tyvek™ jumpsuits used in the cleanest clean room areas are sold to a company that launders the suits and resells them to the oil industry. The company was recently recommended for ISO 14000 certification by an external ISO certification body.



Hyland Immuno reduced the amount of virgin materials used in this waste neutralization system, where most of the plant's biohazardous waste is treated.

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ISO 14000 group has close encounter with *muda*, *kanban* at NUMMI

Hosts at New United Motor Manufacturing, Inc. (NUMMI)—Tom Sinclair, Stuart Rupp, and Gary Twisselmann—frequently used unfamiliar Japanese words like *muda*, *kanban*, *jikoda*, and *kaizen* during a tour of their Fremont, Calif. plant. It turns out these four words are the cornerstones of the Toyota Production System, the foundation of the Toyota-General Motors joint venture where the Chevrolet Prism, Toyota Corolla, and Toyota Tacoma truck are manufactured.

During their visit, the Defense Programs' workshop ISO 14000 group learned how the four cornerstones drive both production efficiency and environmental policy at the NUMMI plant. The 4.5 million square foot factory opened in 1984 and currently employs about 4,500 workers, producing 220,000 cars and 150,000 trucks each year—a finished vehicle leaves the assembly lines about every 61 seconds.

Company environmental policy is explicit: "NUMMI will conduct its automobile and truck manufacturing operations in Fremont in a manner which conserves natural resources and protects the environment." The policy encourages manufacturing team members to maintain and improve programs to prevent pollution and recycle materials, and to eliminate waste in resources and energy.

Eliminating waste is *muda*.

In the spirit of *muda*, the workshop group toured the plant materials recovery facility where cardboard and white paper are collected and baled for recycling. White paper use is down because most NUMMI system documents are available only on the company intranet. A new painting system has cut down on the use of VOCs through reuse of solvents during paint color changeover. Recycle of deionized water has helped NUMMI reduce its potable water consumption by over 30 percent. This voluntary reduction guarantees the plant an adequate supply of water from the local utility in times of regional water shortages.

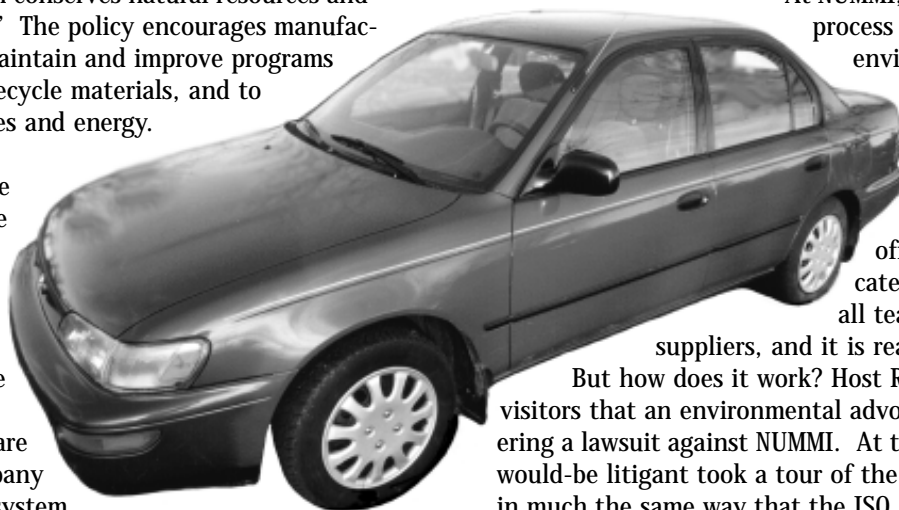
Conserving inventory—the stock of parts and materials on hand—is *kanban*, or "just-in-time." Team members are encouraged to minimize the amounts of hazardous materials on site at any given time. Bulk storage transfer tanks are used to avoid excess handling and movement of chemicals. *Kanban* also applies to production goals: every vehicle that leaves the plant is already sold.

At their work stations on the plant floor, procedures are standardized. Every worker has a handle that can stop the line—if a task takes more than 61 seconds, the line is stopped and other workers come over and help to finish the task. There is a no-fault policy for stoppages. Team members are likewise encouraged to report environmental problems. This system led to NUMMI replacing cardboard boxes for shipping parts with reusable, collapsible plastic containers with a projected six-year useful life, which saved \$62,636,000 between 1996 and 1999. Quality at the work station is *jikoda*.

Environmental policy at NUMMI is closely tied to ISO 14000 environmental management system (EMS) standards. For example, there are documented procedures for identifying and responding to emergencies and for preventing and mitigating their environmental impacts. Key characteristics of operations with significant impacts are measured and monitored. Responsibility and authority for corrective action where operations do not conform to environmental management standards are well-defined, and non-conformance is constantly sought out and investigated, the effects mitigated and the operations corrected. EMS records are identifiable, traceable, and readily available. Audits assure that the EMS conforms to ISO standards and that it has been correctly implemented in plant operations. NUMMI management regularly reviews the EMS for suitability, adequacy, and effectiveness and recommends and implements changes. The NUMMI approach to environmental management is based on *kaizen*—constant improvement.

At NUMMI, *kaizen* means improving the process to reduce its impacts on the environment. Team members are rewarded for suggestions that improve the process—it is company policy that no suggestion will ever result in an employee being laid off. The company communicates its environmental policy to all team members, contractors, and suppliers, and it is readily available to the public.

But how does it work? Host Rupp told the workshop visitors that an environmental advocacy group was once considering a lawsuit against NUMMI. At the company's invitation, the would-be litigant took a tour of the plant and reviewed the EMS, in much the same way that the ISO 14000 group had just done. There was no lawsuit.



Toyota Corolla

Contact Bryant Poston, McPherson Environmental Resources, Inc., 423-336-2605 or bnposton@mindspring.com and Tom Sinclair, 510-498-5797 or tsinclair@nummi.com

First bagasse plant in North America opens in bayou

There are five other bagasse-to-particleboard plants in the world, but the Acadia Board Company plant in New Iberia, La. is the first in North America. The plant has begun production of DuraCane™, a particleboard made of bagasse, the fibrous portion of sugar cane stalks that remains after removing the juice in sugar production. DuraCane is being marketed for building ready-to-assemble furniture, kitchen and bath cabinets, and laminate flooring. The New Iberia facility will use 50,000 tons of bagasse to produce 18 million square feet of 3/4-inch board. DuraCane is expected to exceed ANSI standards for particleboard, but doesn't meet all of those for medium density fiberboard (MDF). DuraCane is bonded with MDI (methylene diphenyl diisocyanate), a formaldehyde-free resin. —*The Carbohydrate Economy, Fall 1999*

Barriers falling for DOE/AL's national pollution prevention leader

Mike Sweitzer is working to change how pollution prevention gets done in DOE.

Sweitzer has managed the Pollution Prevention Program for the Department of Energy Albuquerque Operations Office (DOE/AL) since 1997. He joined DOE/AL in 1995 after 12 years in radiological control, environmental compliance, and as Waste Manager at Mare Island Naval Shipyard in Vallejo, Calif.

DOE/AL was named DOE's Center of Excellence for Pollution Prevention in 1996. In late 1997, Sweitzer took over the responsibilities of spearheading the Center's National P2 Program for the Office of Environmental Management as well as leading the P2 Program effort at DOE/AL sites.

A major accomplishment of the DOE/AL National P2 Program under Sweitzer's leadership was the release late last year of the Department's official *Environmental and Energy Efficiency Leadership Goals*. This involved obtaining Energy Secretary Bill Richardson's signature as well as garnering hard-won support from each of DOE's program offices.

"Everybody needed to have input into those goals," Sweitzer said. "Pollution prevention and environmental responsibility are everybody's job."

In conjunction with support for the Departmental goals, Sweitzer noted, "the (DOE) Pollution Prevention Conference 99 in November was our biggest success. DOE/AL was the lead for the conference, and we were responsible for putting the conference together." The Albuquerque conference brought DOE leadership together under the P2 banner as never before,

including keynote speaker Deputy Secretary T.J. Glauthier and Environmental Executive Dan Reicher, as well as the heads of DOE Environmental Management, Economic Impact and Diversity, Environmental Health, and Management and Administration. Many other DOE program offices sent high-level representatives.

"One of the greatest successes (of the P2 Conference) was that all these people attended and talked about P2," Sweitzer said. "I think the conference created a great opportunity for the Department's P2 Program. I am working to ensure this opportunity is fully realized to reinvigorate the program throughout the Department."

"Another thing that I'm really focused on is taking down the barriers to P2 between the various program offices," Sweitzer continued. Because of the way P2 has been organized within DOE, small groups have been largely responsible for pollution prevention activities within programs. "I've been working hard to break down the stovepipes to have everyone work together for the common cause," he said. "Some barriers have come down, but a lot of work remains."

Sweitzer added, "I am proud to be a part of the P2 Program within DOE. Throughout my

career, I have never had the privilege to work with so many people in a single program who were so dedicated and passionate about their work. With all the issues the Program faces, it is encouraging to see so many people staying with this Program and not giving up. It's a pleasure for me to be part of this dedicated group."

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Mike Sweitzer responds to a comment in a group discussion at the February Defense Programs' workshop in Berkeley, Calif.

From 'Hybrid Lighting' on page 1

"Our approach leverages the benefits of concentrating photovoltaic cells in the near-infrared portion of the spectrum, where they are generally more efficient," said Jeff Muhs, Hybrid Lighting Program Manager in ORNL's Engineering and Technology Division.

The challenge, as spelled out in a lab profile on the project, is to maintain uniform lighting, even as the level of sunlight fluctuates; in order to use the sun's visible light for interior lighting, it must be combined with artificial light. This mixed-source, or "hybrid," lighting provides additional benefits, such as the elimination of glare and reduced energy consumption during peak demand periods.

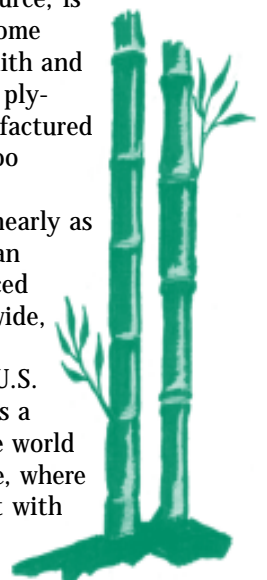
ORNL models suggest that a "full-spectrum solar energy system" could increase by three times the overall efficiency of solar energy for commercial buildings. Interior lighting is the greatest single use of electrical power in commercial buildings and accounts for more than a third of all electricity consumed commercially in the U.S.

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Market grows for versatile bamboo as construction material

Bamboo, a fast-growing, renewable resource, is attracting more interest in the U.S. as a home accessories and construction material. Smith and Fong of San Francisco imports Plyboo™, a plywood paneling and flooring product manufactured in China from kiln-dried, laminated bamboo strips.

"Plyboo flooring is twice as stable and nearly as hard as standard red oak flooring," said Dan Smith, adding that it is competitively priced as well. Popular though it may be worldwide, few U.S. designers use bamboo, possibly because it has yet to be approved by any U.S. building codes. Proof of bamboo's value as a construction material may be found at the world fair opening in Hannover, Germany in June, where a 9,000-square-foot pavilion is being built with bamboo components. —*In Business*, November/December 1999



Pantex composting uses some basic ingredients to defuse HE soils

A team at the Department of Energy (DOE) Pantex Plant in Amarillo, Texas is successfully employing full-scale windrow composting of high explosive (HE)-contaminated soils as part of environmental restoration at the Plant.

Scrap HE and HE-contaminated components generated during the manufacture of both conventional and nuclear weapons were historically dispositioned through controlled detonation and burning at the Pantex Burning Grounds, located in the northern portion of the Plant. Consequently, soils at this location were contaminated with barium nitrate and HE.

The Pantex HE Composting Technology Deployment project includes systematic soil removal and treatment which decreases the concentration of HE to a non-hazardous level. The soil is disposed of in the Pantex on-site Environmental Landfill Cell.

The windrow composting facility consists of two 270-foot long modular structures, each with the capacity to house three windrows. The volume of contaminated soil treated in each windrow is approximately 100 cubic yards.

Key factors contributing to the design and construction of the project were effectiveness and cost. Therefore, identification of optimal amendments and utilization of easily obtainable and relatively inexpensive resources were basic goals. These goals were met by using locally available materials for composting amendments, such as steer manure from a local feedyard and second-cycle wood chips from a municipal composting operation; procuring locally available equipment to construct the modular facility; adding mycelium from white rot and other fungi to increase the efficiency of HE mineralization; and the use of sulfate-based fertilizers to serve as terminal electron acceptors

for microbial metabolism; and chemically converting soluble barium to relatively insoluble barium sulfate.



Soil with residues of high explosives is mixed with manure and wood chips in a composting operation at the Pantex Plant.

The Office of Environmental Restoration (ER) Soil Remediation Section Manager responsible for the Pantex HE Composting Technology project Jay Childress said, "By the end of [calendar year 1999], we [had] treated about 3,000 cubic yards of HE contaminated soil. The cost of composting is about \$82 per cubic yard, compared with somewhere around \$396 per cubic yard for disposing of the soil as Class I waste. Using this technology, we estimate that we saved the DOE over \$940,000."

The DOE is accomplishing this project through an Accelerated Site Technology Deployment (ASTD) project managed by the ER Department at Pantex, supported by S.M. Stoller Corporation. The overall ASTD program, managed by the Subsurface Contamination Focus Area, employs an observational expedited approach for sites requiring specialized remediation.

The clear reduction in treatment, disposal, and transportation costs has prompted plans for expanded application of the innovative composting technology in FY 2000 at Pantex. Also, as a result of the demonstrated savings, export of the technology to other DOE sites is being considered for curbing long-term liability costs for the DOE Environmental Restoration Program.

The Pantex Plant, currently managed by Mason & Hanger Corporation, historically operated as a manufacturing plant for conventional weapons during World War II and was subsequently converted to the assembly and disassembly of nuclear weapons.

Contact Laura Pendlebury, DOE Amarillo Area Office, 806-477-3177 or lpendleb@pantex.com

Hanford transfers rubble-reducing machine to Mound

Bechtel Hanford, Inc., working in partnership with DOE's Richland Operations Office to reduce waste disposal costs at DOE sites across the country, transferred a surplus concrete crushing unit to the DOE's Ohio Field Office in October 1999. The concrete crusher reduces the amount of building rubble waste from decontamination and decommissioning projects sent for off-site final disposal to the Nevada Test Site. By crushing hundreds of cubic feet of building rubble and reducing volumes, DOE expects to save \$4 to \$12 million over the next three years. The lower estimate represents the volume



A massive concrete crusher like this one was transferred from the Richland Operations Office to the Ohio Field Office.

reduction achieved if all the rubble was to be sent to off-site disposal. The higher estimate assumes that rubble that has been verified as clean and can be reused as backfill at remedial action sites at Mound. This property transfer also eliminated the need for purchase of a concrete crusher by the Ohio Field Office, a cost avoidance of an estimated \$750,000.

Contact Doug DuVon, Bechtel Hanford, Inc., 509-372-9182 or dkdudon@bhi-erc.com

Energy Technology Center becomes fifteenth National Laboratory

U.S. Department of Energy (DOE) Secretary Bill Richardson elevated the Federal Energy Technology Center, with campuses in Morgantown, W.V. and Pittsburgh, to National Laboratory status as the National Energy Technology Laboratory (NETL), making it DOE's fifteenth National Laboratory. The two sites "have been at the forefront of advancements in fossil fuel and environmental technologies" for much of this century, Richardson announced in December. The designation will "include it as a full-fledged member in the most comprehensive research system of its kind in the world, while at the same time retaining its unique government-owned, government-operated status," he added.

NETL has also been declared DOE's Strategic Center for Natural Gas, with "greener-sooner" as its motto. The "new" lab is structuring research around four Centers of Excellence in fossil energy science: Computational Energy Science, Carbon Sequestration Science, Combustion and Gas Energy System Dynamics, and Ultra-Clean Fuel Science and Technology.

Contact Larry C. Headley, DOE Office of Science and Technology, 304-285-4314 and go to <http://www.netl.doe.gov>

Choose 'a brighter future'

A new 32-page booklet from the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory, *Choices for a Brighter Future: Perspectives on Renewable Energy*, provides an overview of the opportunities and challenges surrounding the greater opportunities to use renewable energy in the U.S. Because the utility industry is becoming deregulated and reorganized, more Americans will have the chance to choose electricity suppliers. Renewable energy sources like solar, wind, biomass, geothermal and hydropower can provide reliable electricity while reducing environmental concerns.

Go to <http://www.eren.doe.gov/power/choices.html>

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